Fermilab

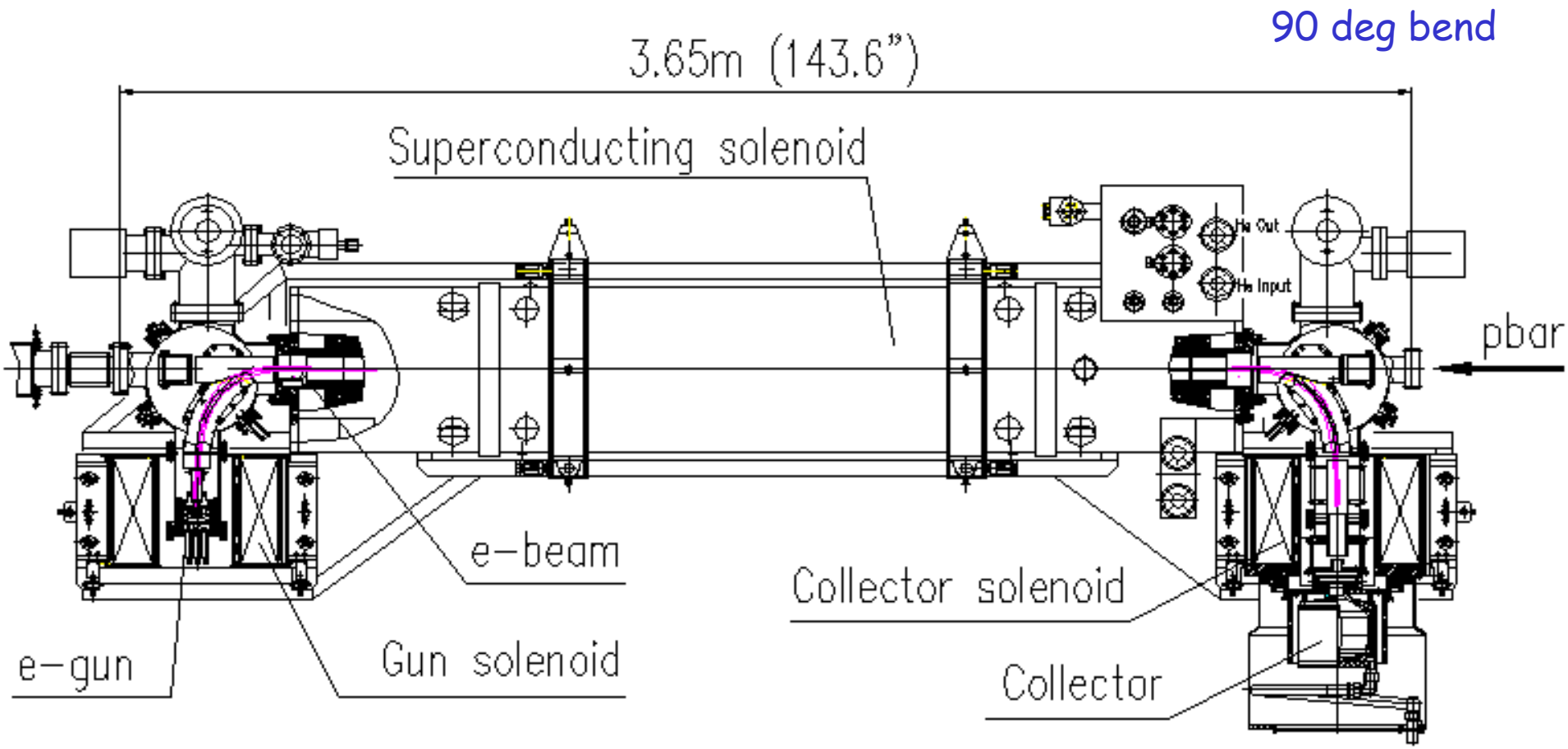
Status of TEL-2 Hardware

Vladimir Shiltsev

Content:

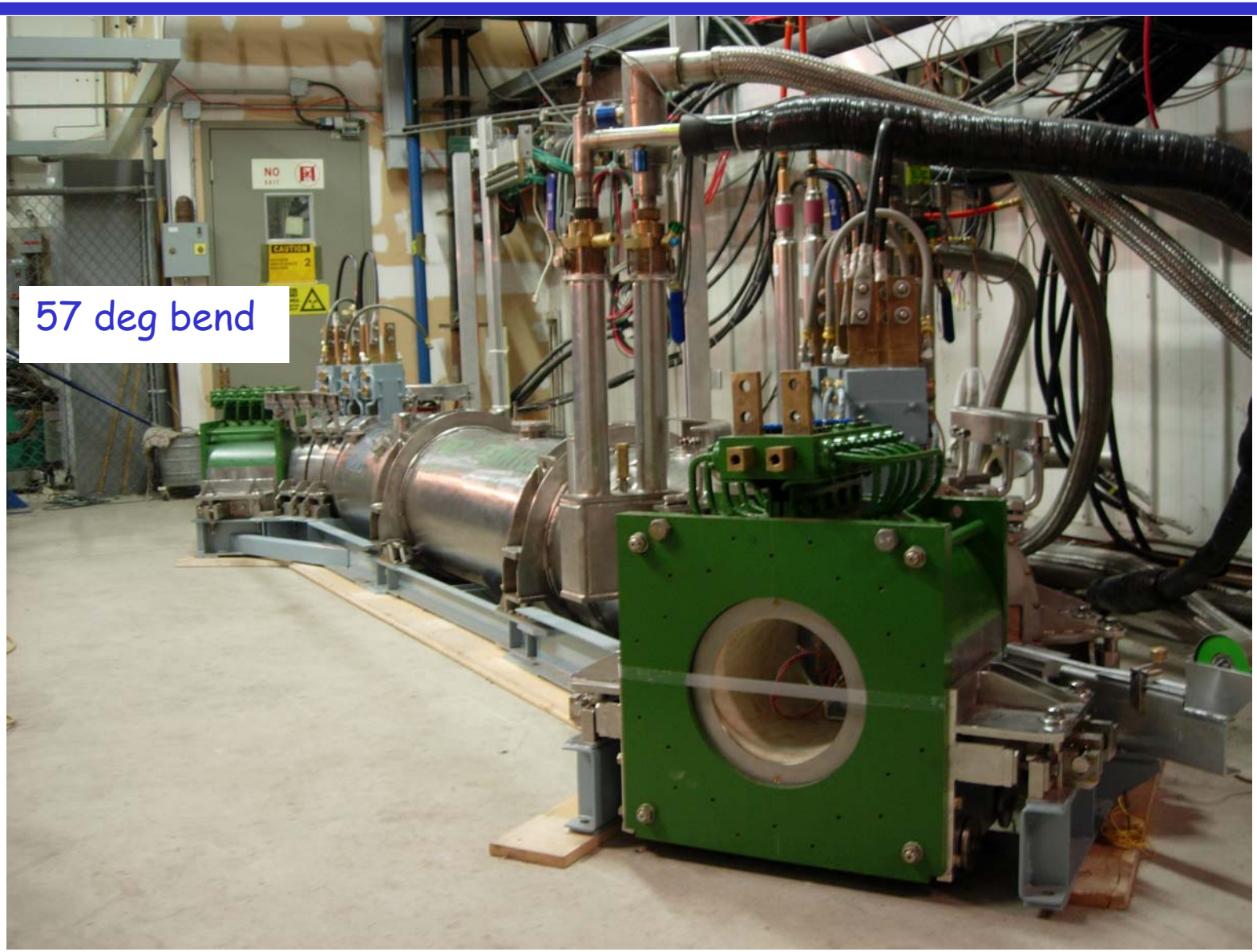
- TEL-2 / TEL-1 differences
  - location, magnets
- Checkup List
- Electron guns
  - three types
- HV modulators
  - Requirements

Tevatron Electron Lens (TEL-1)

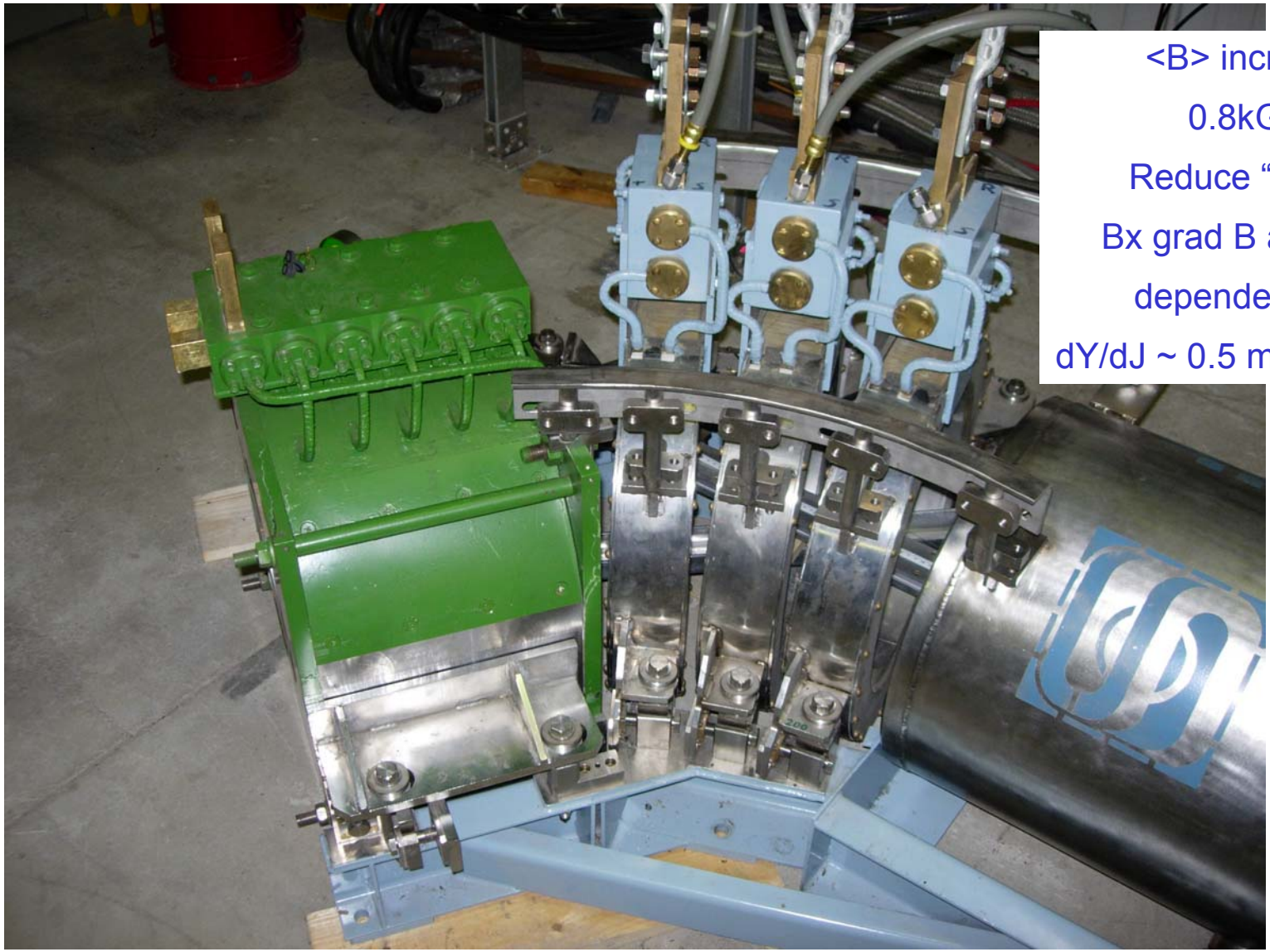


+ HV Modulator, HV+HC PSs, Cryo, QPs, Vacuum, Controls, Diagnostics, Cables

TEL-2 at E4R



Bending Section



<B> increased from

0.8kG → ~2kG

Reduce “gradient” drift

Bx grad B and it’s current depended component

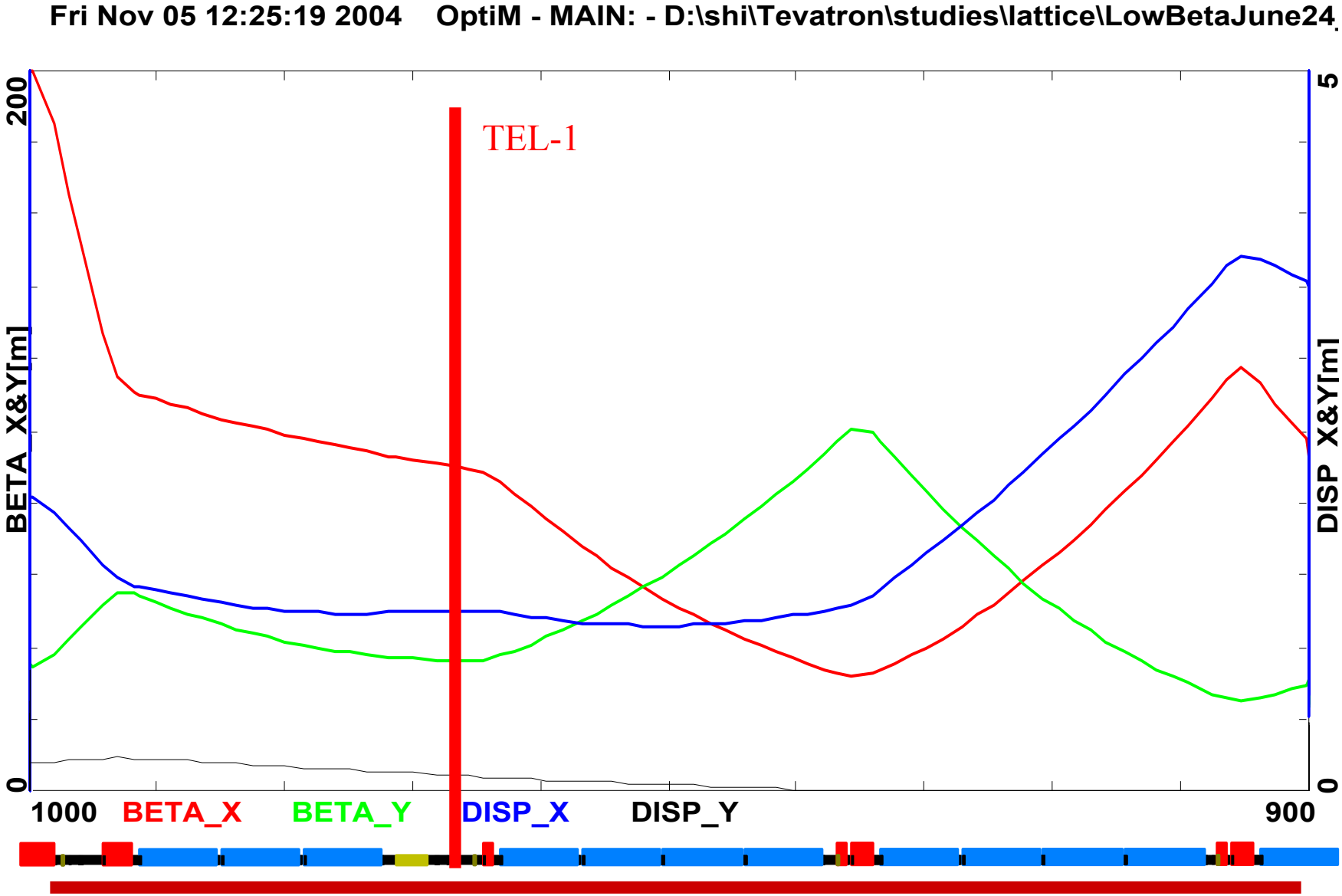
dY/dJ ~ 0.5 mm/A → 0.1 mm/A

Plan of Cold Magnet Tests at E4R

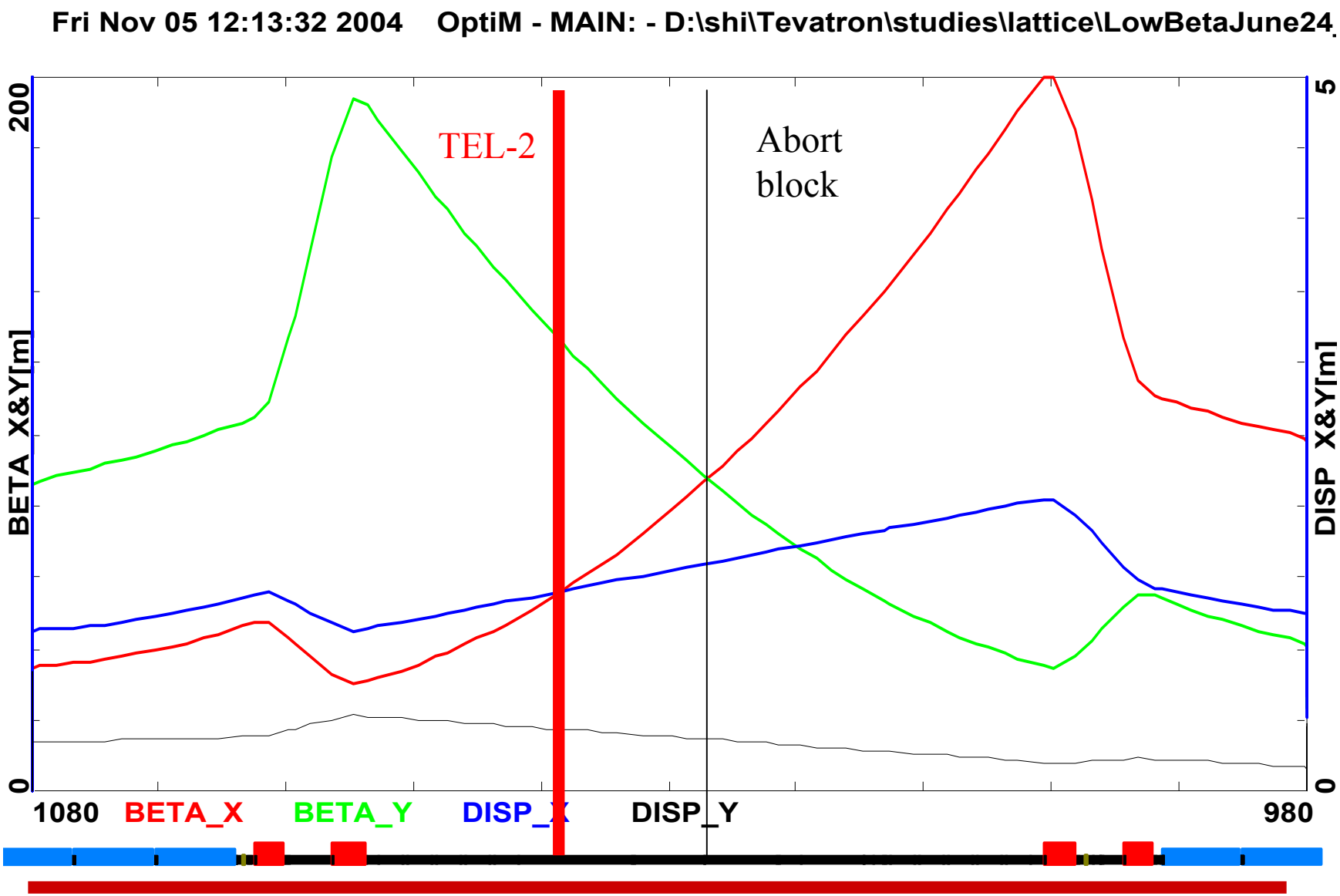
I.Bogdanov,
L.Takachenko,
S.Kozub

1. Study of training of SC solenoid:
   Power up to 6.7 T with 1-A/s ramp rate;
   Power with 5, 10, 20 and 30 A/s up to 6.7 T.
2. Measurements of the central magnetic line and lines (r = 3 cm, φ – 0, 90, 180, 270, 360°) in the main solenoid at 1.6, 3.5 and 6.5 T by the magnetic arrow with mirror.
3. Measurement of magnet constant (transfer function) B/I versus I in the center of the main solenoid up to 6.7 T.
4. Measurements of transfer functions B/I versus I for each SC dipole at de-energized main solenoid and at 6.5-T central field in the main solenoid.
5. Measurement of distribution $B(0, 0, z)$ for main solenoid at levels of central fields 1.6, 3.5 and 6.5 T.
6. Measurement of distribution $B(0, 0, z)$ for each SC dipole at operating current of SC dipole and at de-energized SC solenoid.
7. Measurements of distribution of field components along lines: ΔL = 80 cm, beginning from 30-cm inside of SC solenoid, x = 0, ±1 cm at 6.5 T and at operating current in the short vertical dipole and rotary and gun (collector) solenoids.
8. Calculations of integral field harmonic b_3 and compare with the value of Tevatron main dipoles.
9. Measurements of the edge field map (ΔL = 80 cm beginning from 30-cm inside of SC solenoid, x = 0, ±1, ±2, ±3, ±4, ±5 cm) at turned on rotary and gun (collector) solenoids in operating modes (1.6 – 0.4 T) and (6.5 – 0.4 T).
10. Measurements of the field maps in the median planes (30-cm inside of SC solenoid, r = 0, ±1, ±2, ±3, ±4, ±5 cm) in the rotary sections at turned on rotary and gun (or collector) solenoids in operating modes (1.6 – 0.4 T) and (6.5 – 0.4 T).
11. Restore of the magnetic lines using field maps and compare with calculated ones.
12. Measurements of the longitudinal axial field/gradient distribution in the correcting conventional coils at their commutation dipole/quadrupole and calculations of the integral field of these coils.

Lattice Functions at TEL-1 (F48)



Lattice Functions at TEL-2 (A0)



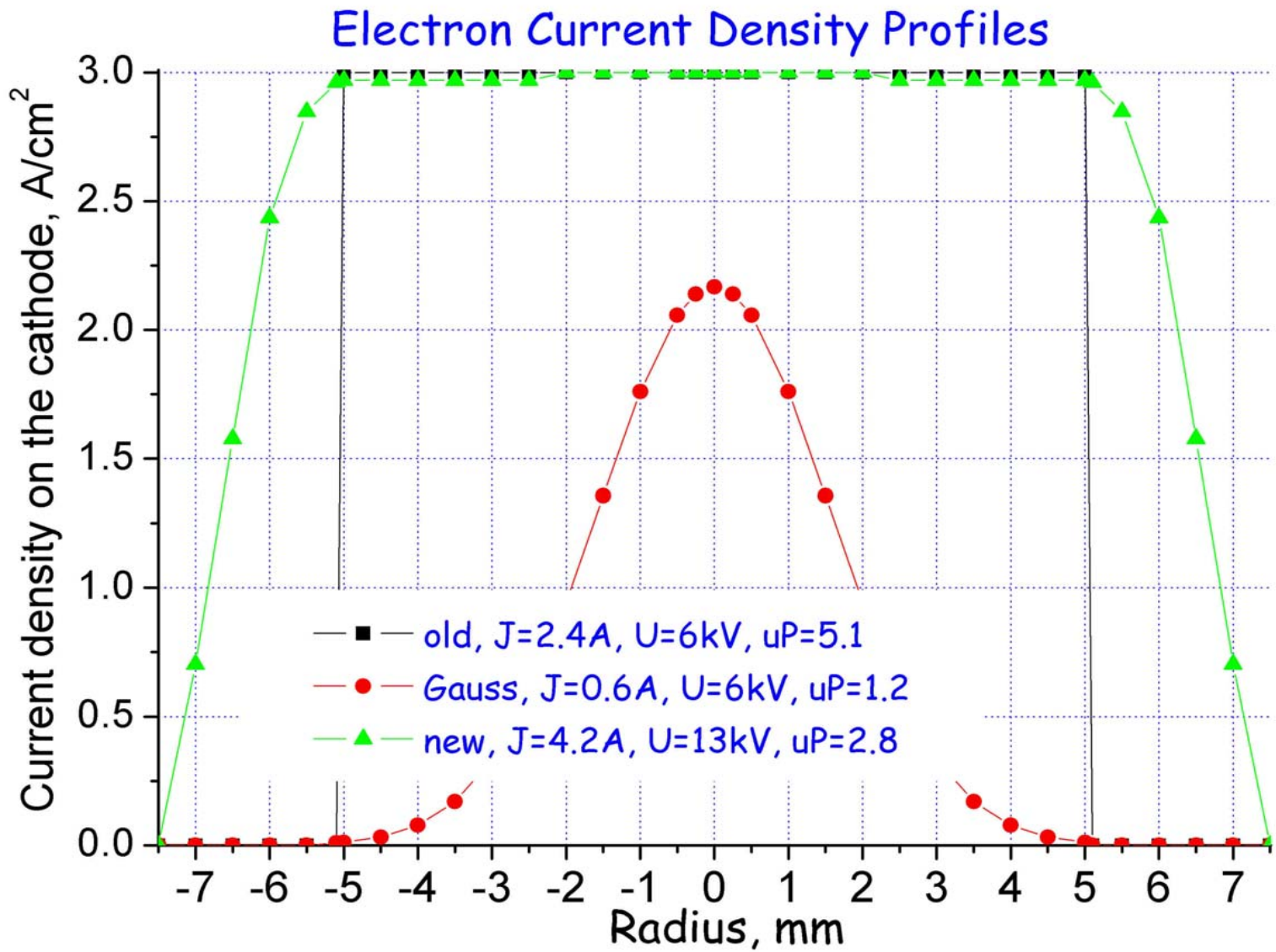
Summary of Two TELs

	Tel-1	Tel-2
β_x, m	100	49
β_y, m	30	136
D_x, m	1.8	2.1
dX_{co},mm	5.8	5.2
dY_{co},mm	1.4	-5.6
σ_x, mm	0.63	0.49
σ_y, mm	0.31	0.67

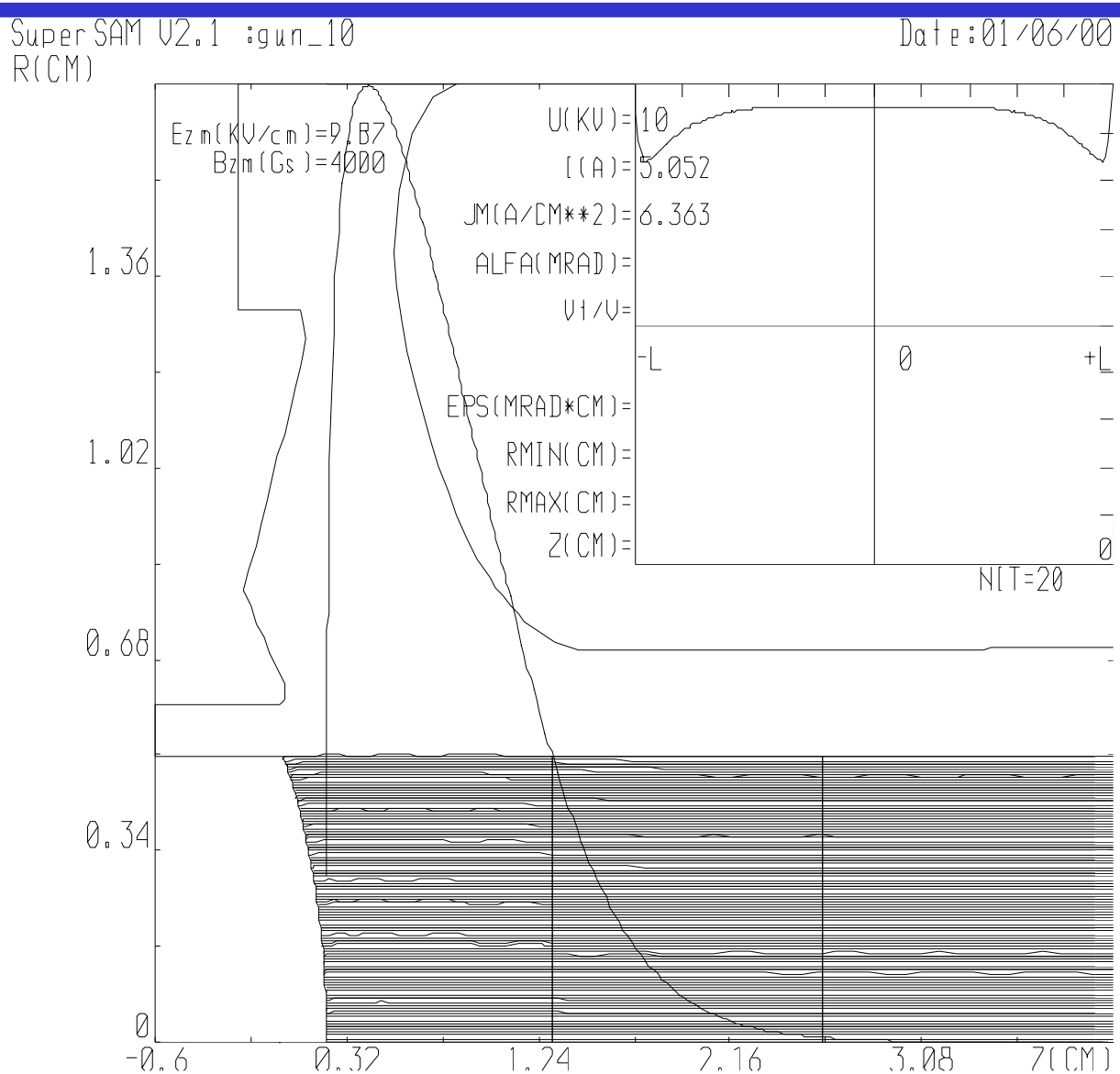
Check-up List

	#1	#2	spares	comm.
Magnets	√	√	no	later
Cryo	√	no	no	will build
PSs	√	~	√	
HV pulser	√	no	√	will use spare
e-gun	√	~	√	under design
Collector	√	no	~	will use spare
Vacuum	√	~	no	

Need wider beam => new HV modulator

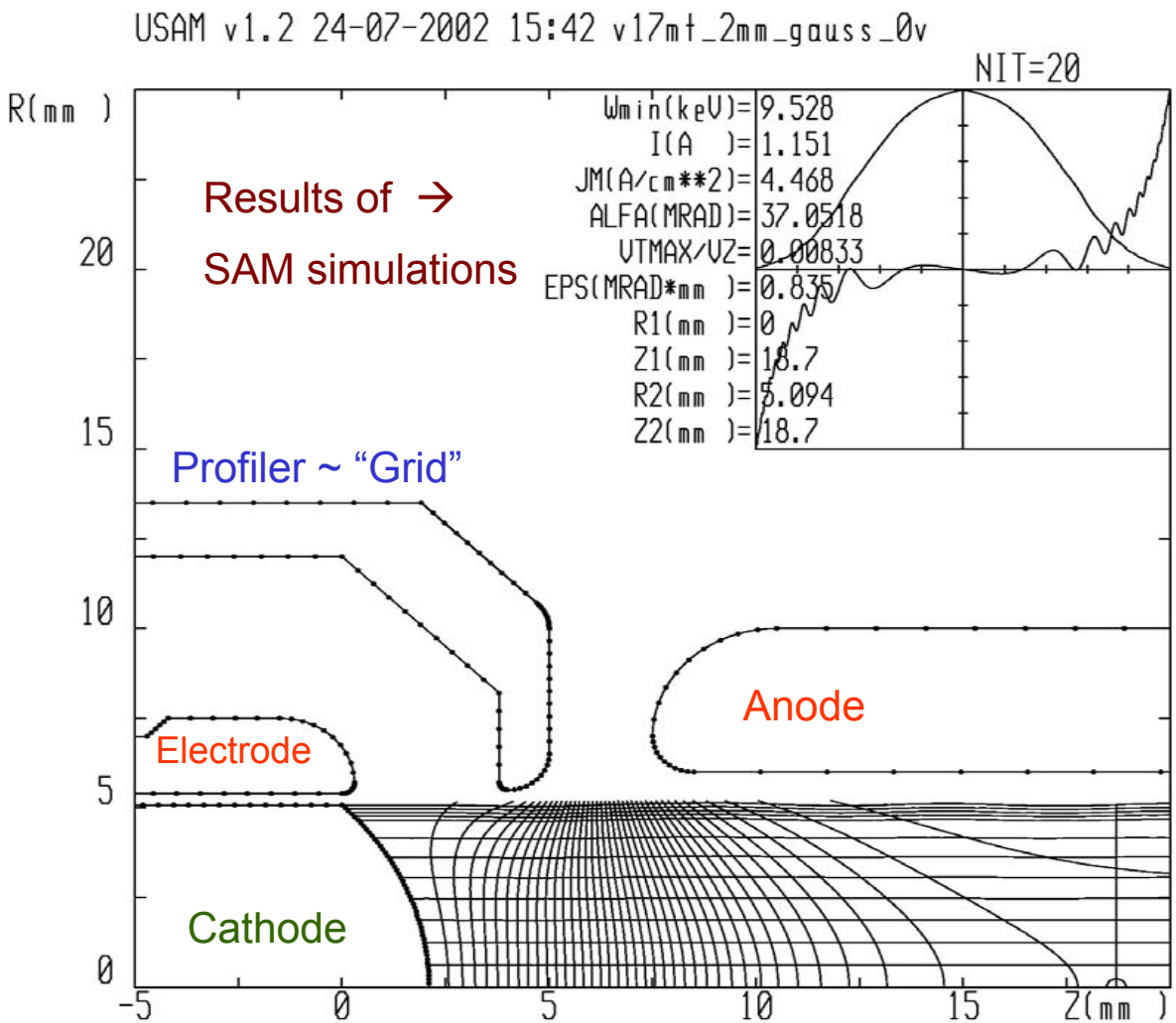


The First Gun



Operated
2001-02

Need of Smooth Edges → Gaussian Gun

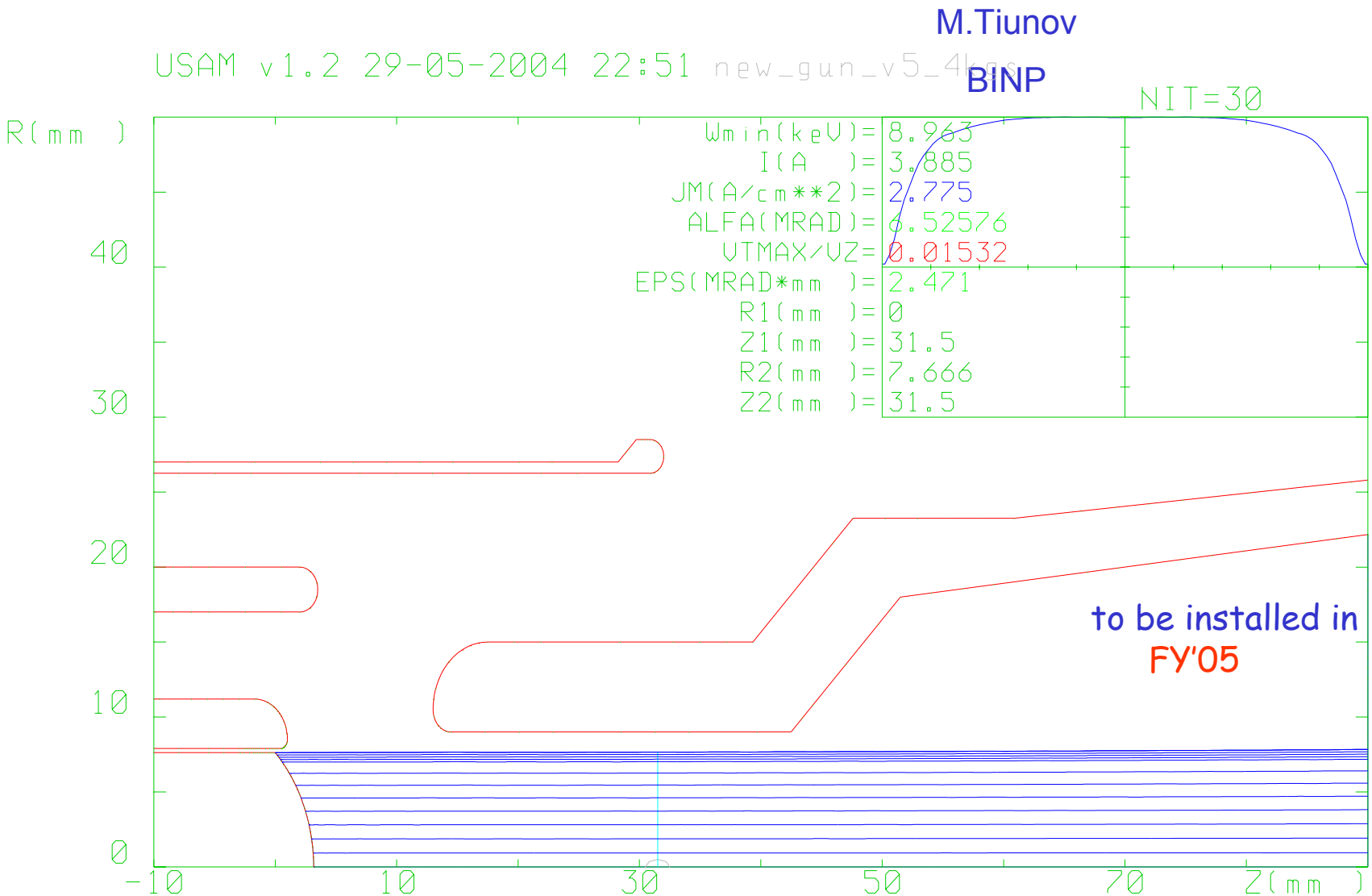


M.Tiunov

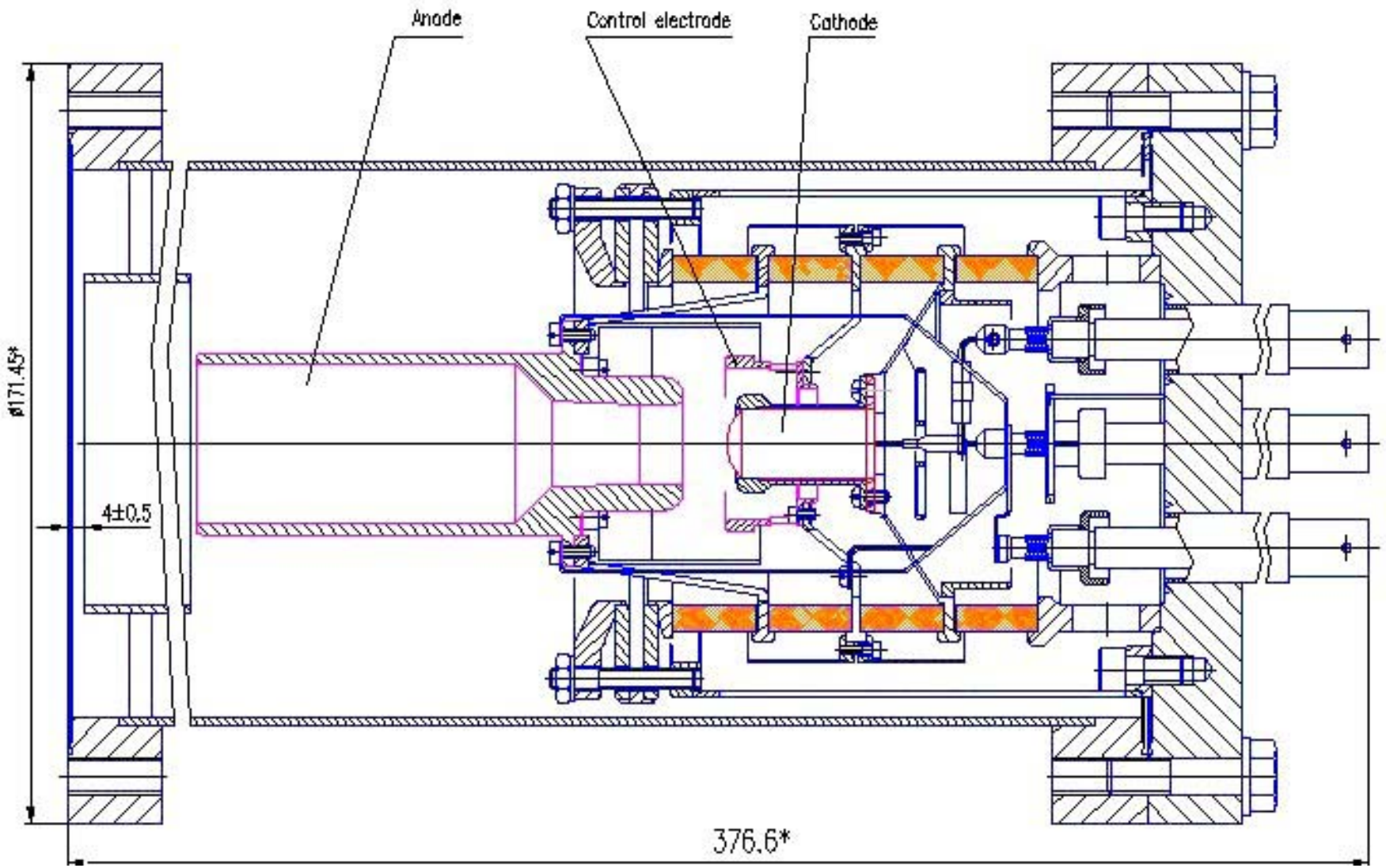
BINP

Installed in Jan'2003

Need of Flat Top → SEFT e-Gun



SEFT e-Gun "Smooth Edge+Flat Top"

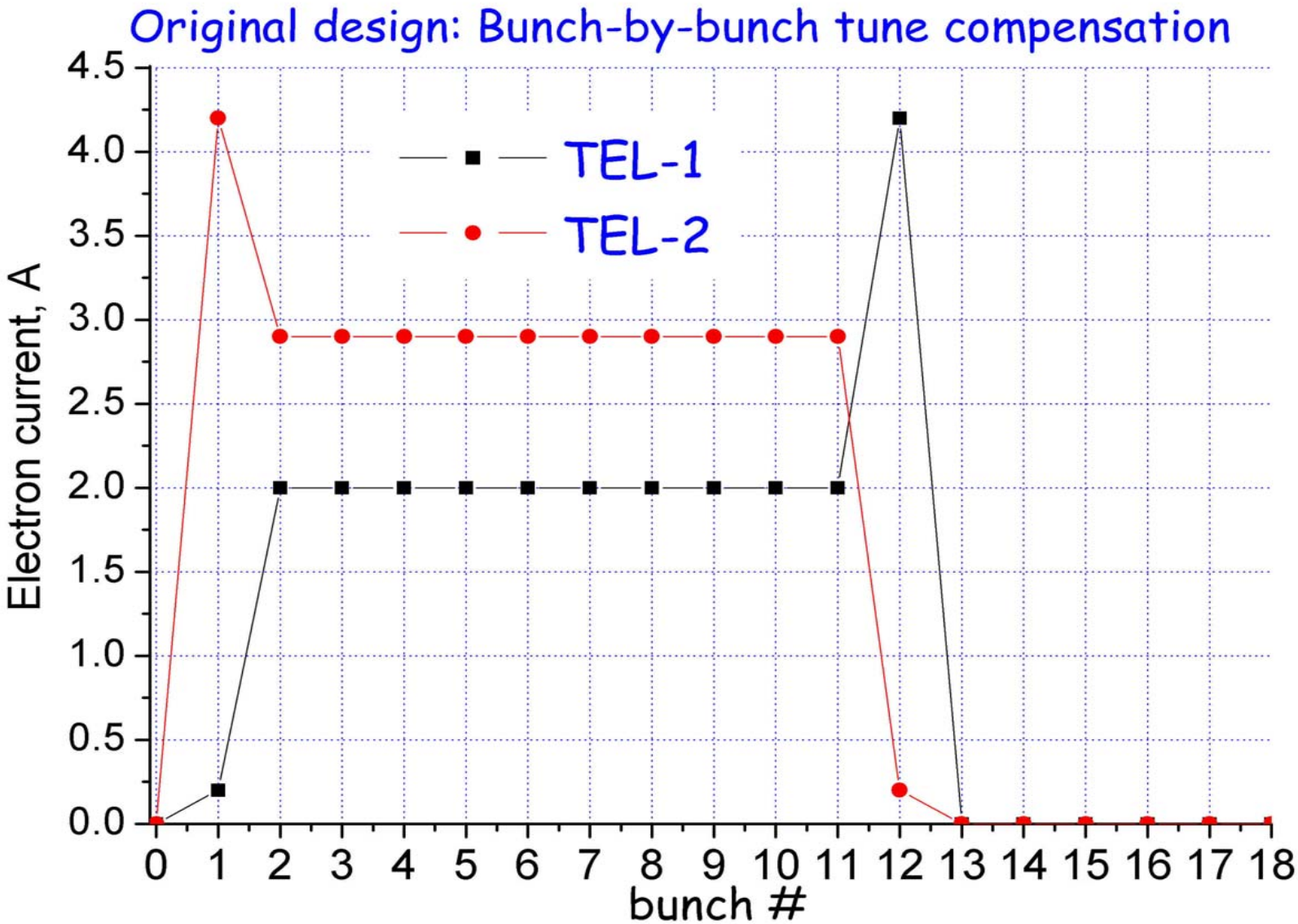


Summary of TEL e-Guns

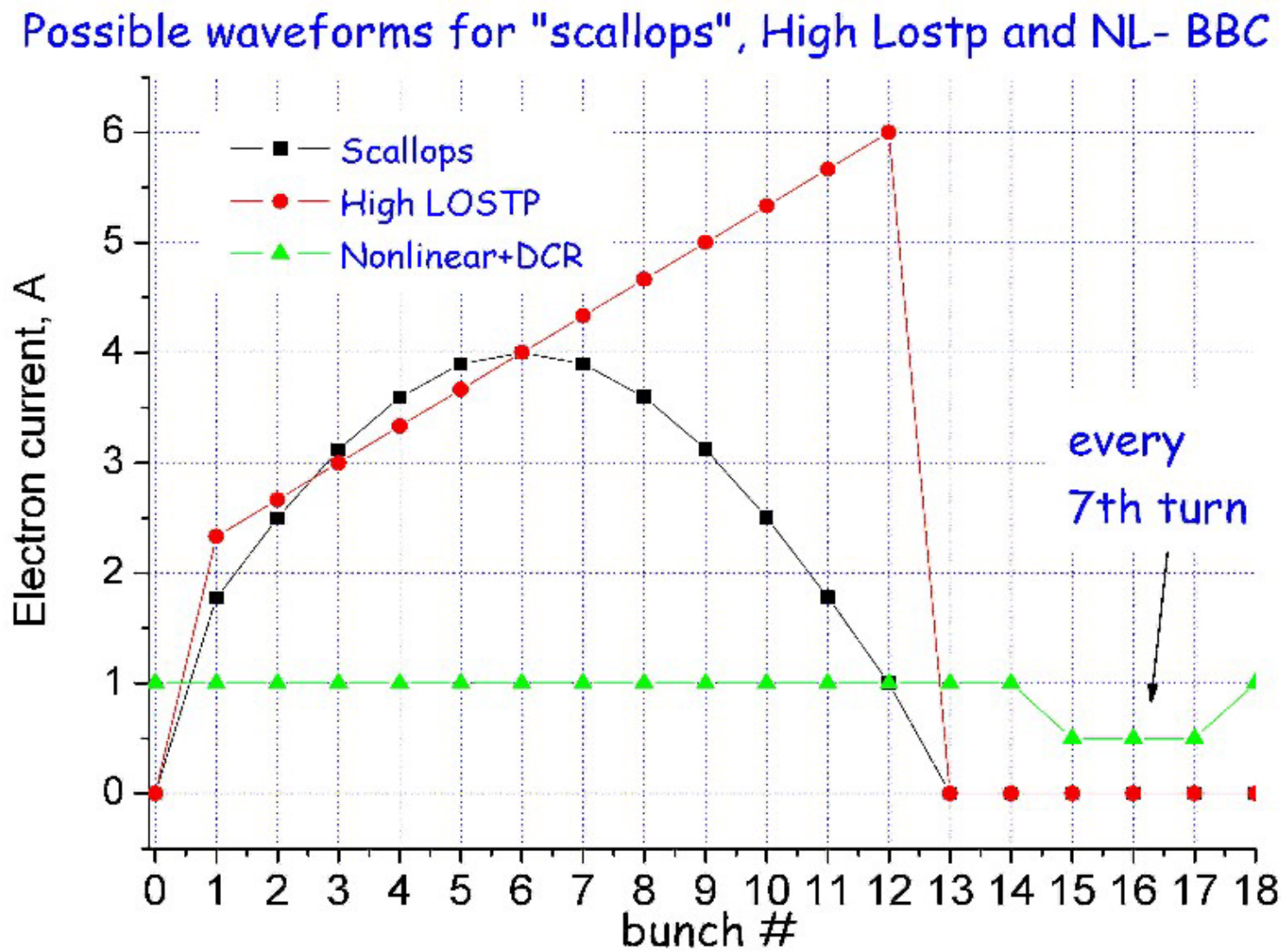
	Flat	Gauss	SEFT
μP	5.1	1.15	3.9
j_{max}, A/mm (at Va=10kV)	6.4	4.5	2.9
V_a, kV (for dQ=0.005 TEL-1 Ue=7kV)	5.0	6.3	8.6
V_a, kV (for dQ=0.01)	7.9	10.0	13.7

... currently we get Va ~ 6 kV

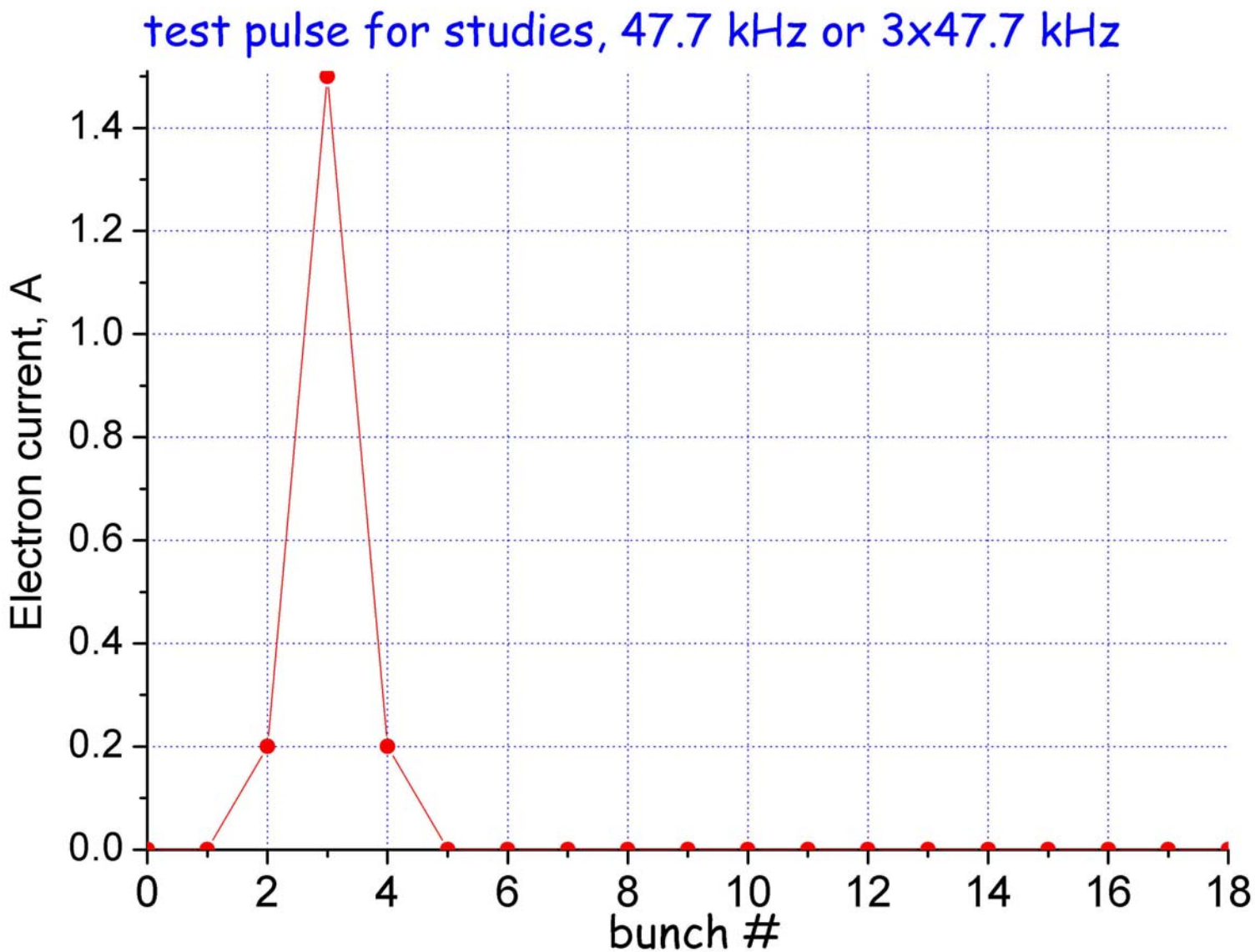
HV Output Waveform depends on what to BBC



or like that… ?


Possible waveforms for "scallops", High Lostp and NL- BBC
Scallops
High LOSTP
Nonlinear+DCR
every
7th turn
Electron current, A
bunch #
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

For single bunch studies during store



e-Pulse Affects 2 Bunches Now